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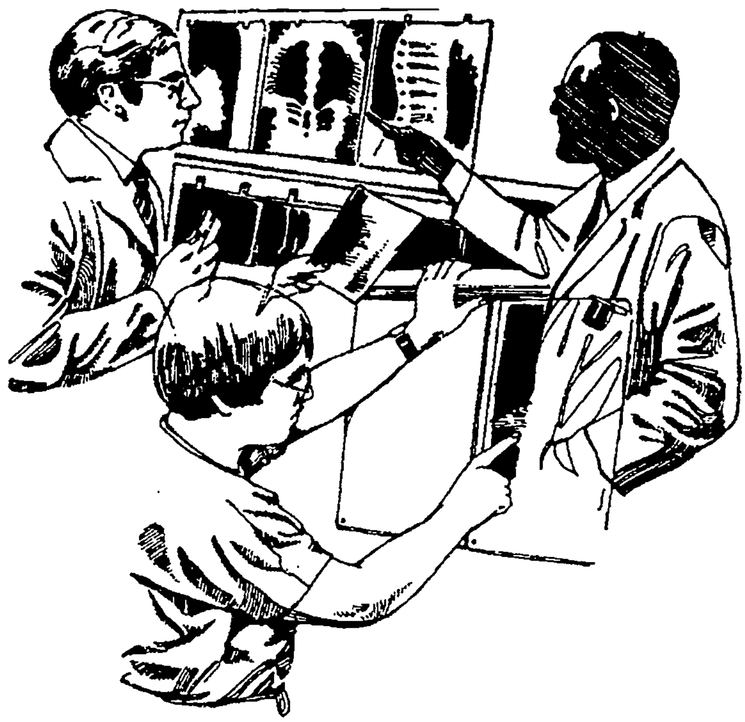
ABSTRACT

This module presents a real-world context in which mathematics skills are used as part of a daily routine. The context is the radiological technology field, and the module aims to help students use ratios and exponents as part of real-life problem solving. Materials in the module, most of which are designed for the teacher to duplicate and distribute to students, include the following: (1) information on careers in the field of radiological technology; (2) a task to be performed; (3) task skills, information sheets, related problems, and a teacher's answer key; and (4) a glossary. (KC)

MATHEMATICS FOR THE WORKPLACE



APPLICATIONS FROM RADIOLOGICAL TECHNOLOGY

A TEACHER'S GUIDE

Developed by:

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Special thanks to Dr. Margaret "Peggy" Champion, former head, Tri-County Technical College Veterinary Technology Department for her help in initiating the development of this module.

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INTRODUCTION

This module provides an additional resource for teaching ratios and exponents using applications from the allied health field of Radiological Technology.

Teachers may use the module as supplemental material for such courses as General Math III, Technical/Applied Mathematics, or Algebra I.

An additional suggestion concerning the use of this module is to invite, when possible, a radiological technologist to speak to the class. The module could then be implemented as a follow-up activity for the next several days giving students an opportunity to work problems associated with a radiological technologist's job responsibilities.

Please keep in mind that the module developers offer these ideas only as suggestions. Each teacher and/or district should decide where the module best fits into the overall structure of the curriculum.

RATIONALE FOR THE UNIT

Many times students have difficulty relating concepts and theories presented in the classroom to real-life situations. This problem may occur when information is presented in an isolated setting. Therefore, students who are unable to see a connection between what is taught and a real-world applications may become disinterested in the subject or lose motivation. Consequently, the student perceives no need to apply himself to his studies and may not take courses which challenge him as a learner.

This module is designed to provide a real-world context where ratios and exponents are used as part of a daily routine. Providing examples from real-life settings helps students better-understand the need to study and to learn the mathematical concepts taught in the classroom. Real-life applications can provide the needed relevance to motivate students, not only to apply themselves to their studies, but also to take the highest level of mathematics they are capable of handling successfully.

HOW TO USE THIS MODULE

The table of contents in this packet lists the materials encompassed within the module. This is a teacher's guide, not a packet of materials designed entirely to be duplicated and presented to students. There are, however, several sections which should be duplicated and given to the students so they may complete the assigned tasks.

Pages 3 - 5 give the students an introduction to the career field of radiological technology. Included in this introduction is such information as the technologist's duties, where technologists work, and the necessary high school preparation. These pages should be duplicated and given to the students as introductory information.

Page 6 gives a brief description of one specific task performed by the radiological technologist and an explanation of the need for the task. This page can be duplicated and given to students as information.

Pages 7 - 10 explain the specific tasks being presented in the module. These pages can be duplicated and given to the students for them to follow along with the teacher during the explanation of the tasks to be performed.

Page 11 gives additional word problems to be solved by the students once the concepts have been covered in class. This page should be duplicated and given to the students.

Pages 12 - 26 include the answer keys to the Related Problems. Many of the answer keys have two sections because many of the problems require solving ratios which involve two different units of measure (such as feet and inches). In order to solve the problem, the same units of measure must be used. The answer key includes both ways of solving the problems. For example, if Method I uses inches as the unit of measure, then Method II will use feet as the unit of measure.

EXAMINING THE PROFESSION: *radiological technologist*

A radiological technologist assists a radiologist in the use of x-ray and imaging equipment in the diagnosis and treatment of disease or injury.

Radiological Technologists (RTs) must be accurate, skilled, and dedicated. RTs receive training through two or four-year colleges or hospital training programs. Because of the need for radiological technologists in the workplace, students who complete a two-year degree are hired as readily as students with a four-year college degree. Graduates of four-year college programs may have more opportunities to assume managerial positions than two-year college graduates, although advancements opportunities often result from a combination of such factors as education, experience, and job performance.

In order to become registered by the American Registry of Radiologic Technologists, RTs must satisfactorily complete formal training in a program approved by the American Medical Association. Students must pass the registry examination to practice radiological technology and to become nationally certified by the American Registry of Radiologic Technologists.

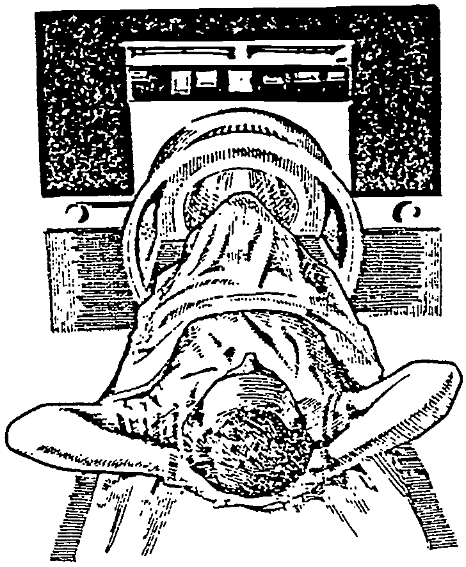
In South Carolina, RTs earned between $15,000 and $22,000 annually in 1988. Radiologic supervisors earned between $20,000 and $31,000 per year in 1988. On the national level, average salary for radiological technologists was $18,000 in 1988. The national average yearly salary for 1988 was $23,000.

Technologists should like:

- dealing with things and objects;
- having direct personal contact with people;
- activities of a scientific and technical nature.

A technologist should be able to:

- see detail in drawings;
- recognize differences in shapes or shadings;
- rate information according to standards that can be measured or checked.



Computer-aided tomography (CAT-SCAN) devices are just one of the machines radiological technologists now use in their daily activities.

Radiological technologists' duties

Radiological technologists perform such duties as:

- arranging devices which lessen discomfort and prevent the patient from moving;
- adjusting equipment to give a clear and accurate view of the patient's body;
- determining proper voltage, current, and exposure time for each x-ray;
- preparing and administering mixtures which patients may be required to take;
- judging the quality of a finished radiograph;
- keeping records and files of x-rays.

Working conditions

Most radiological technologists work in modern, well-equipped hospital radiology rooms. Others may work in medical laboratories or doctors' offices. Technologists usually work a 40-hour week. Evening, weekend, and holiday work as well as emergency duty may be required.

Technologists receive protection from dangerous radiation from leaded partitions, special protective clothing, and gloves.

How to best prepare in high school

In order to be well prepared to enter a program of study in radiological technology, students should take algebra, biology, and chemistry courses.

Students may also consider becoming a volunteer at the local hospital in order to gain understanding and exposure to various allied health careers.

Additional information

Students may receive additional information on radiological technology or other health careers from their high school guidance office, the local hospital, libraries, or through area technical colleges which offer radiological technology programs.

Area technical colleges and hospitals that offer radiological technology programs are:

Greenville Technical College
Contact: Andrew Clarke
Department Head
Radiologic Technology
S. Pleasantburg Drive
Greenville, SC 29606-5616
(803) 242 - 3170

Piedmont Technical College
Contact: Joyce Agner
Coordinator
Allied Health Careers
Drawer 1467
Greenwood, SC 29648
(803) 223 - 8357

Spartanburg Technical College
Contact: Dorothy Kiser
Department Head
Radiologic Technology
P. O. Drawer 4386
Spartanburg, SC 29305
(803) 591 - 3600

Anderson Memorial Hospital
Contact: Gaye Nichols
Program Director
Radiologic Technology
800 North Fant Street
Anderson, SC 29621
(803) 261 - 1249

Understanding the task

One task performed by a radiological technologist (RT) is determining the amount of radiation to administer to a patient and the distance the radiology source must be positioned from the patient. The RT must able to calculate exposure rate or distance correctly to determine how much exposure he/she is also receiving. This will assure that the technologist is not over exposed to radiation during the treatment process.

Why is there a need?

An incorrect distance or an incorrect amount of radiation exposure could result in:

- over exposure, which could cause harm to the patient.
- underexposure, which would not accomplish the desired results.
- harm to the technologist.

What is the task?

Technologists wear lead aprons but this does not prevent all x-rays from entering the technologist's body. In order to further reduce the amount of exposure, two additional exposure management processes can be used. The two processes are exposure time and the distance from the radiation source. By properly calculating either of these process, technologists can further reduce the amount of radiation the body is exposed to. In this module, students will learn how to calculate exposure time and distance.

Exposure

Exposure to a radiation source is directly related to time. The greater the exposure time, the greater the dosage of radiation the patient and/or technologist receives. Since exposure (dosage amount) is directly related to time, a proportion can be set up to determine the amount of time a technologist and/or patient should be exposed to a radiation source.

For example:

> If a technologist receives 40 units of radiation (rads) when working near a radiation source for one hour, how many rads will the technologist receive in 2 hours of exposure?

A direct relationship allows for use of a proportion to determine the amount of exposure in 2 hours.

The proportion for determining either exposure rate (dose) or time is:

$$\frac{\text{dose}(1)}{\text{dose}(2)} = \frac{\text{time}(1)}{\text{time}(2)}$$

Using this proportion we can now find the dose for time(2).

The given information is:

Dose(1) = 40 rads; Dose(2) = x;
Time(1) = 1 hour; Time(2) = 2 hours.

Setting up the proportion, we get:

$$\frac{40 \text{ rads}}{'x' \text{ rads}} = \frac{1 \text{ hour}}{2 \text{ hours}}$$

Cross multiplying, we get:

40 rads X 2 hours = 'x' rads X 1 hour.

Solving for 'x', we get:

80 rads of exposure.

Maximum permissible dosage

In order not to damage his/her body, there is a maximum number of radiation units a technologist can be exposed to during a 40-hour work week. This amount, called the maximum permissible dose (MPD), is 100 units of radiation per 40-hour work week. In order to determine how many hours can be spent around a certain source, divide the MPD by the intensity of the source, which is expressed in units/hours.

EXAMPLE:

If a technologist is assigned to work in a nuclear medicine laboratory where the radiation intensity is 10 units/hours, how many hours can the technologist work in the lab during a given week and not exceed the MPD?

SOLUTION:

Since the MPD is 100 units per 40-hour work week, divide the number of units (100 units) by the intensity per hour (10 units/hour) of exposure. Dividing 100 by 10 we find the technologist can work only 10 hours per week in the lab.

Distance

Distance is how far away from the source the technologist or the patient is located.

The relation between radiation intensity and distance is radiation intensity varies inversely with the square of the distance. The more distance between the technologist or the patient and the source, the less radiation exposure. The less distance between the technologist or the patient and the source, the more radiation exposure.

Intensity varies inversely with the square of the distance because as the radiation leaves the x-ray tube it diverges and covers a larger area. Since area is always involved, the distance must be squared. (Remember--area is always measured in square units.)

Since distance and intensity vary indirectly a proportion can be used to calculate either intensity or distance. This proportion would be:

$$\frac{\text{intensity}(1)}{\text{intensity}(2)} = \frac{\text{distance}(2)^2}{\text{distance}(1)^2}$$

EXAMPLE

If the intensity of radiation at 40" is 300 rads, what would be the intensity at 20"?

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SOLUTION

Using the ratio:

$$\frac{\text{intensity}(1)}{\text{intensity}(2)} = \frac{\text{distance}(2)^2}{\text{distance}(1)^2}$$

we can compute the intensity at 20".

The given information is:

distance(1) = 40"	intensity(1) = 300 rads
distance(2) = 20"	intensity(2) is unknown

Substituting into the proportion, we get:

$$\frac{300 \text{ rads}}{'x' \text{ rads}} = \frac{(20")^2}{(40")^2}$$

Clearing the exponents, we get:

$$\frac{300 \text{ rads}}{'x' \text{ rads}} = \frac{400 \text{ sq. in.}}{1600 \text{ sq. in.}}$$

Cross multiplying, we get:

$$300 \text{ rads} \times 1600 = 'x' \text{ rads} \times 400$$

Solving for 'x', we get:

$$'x' = \frac{300 \text{ rads} \times 1600}{400}$$

or

$$x = 1200 \text{ rads}$$

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Related Problems

1. What is the intensity of radiation at 2 1/2 feet if the intensity at 50" is 4 rads?

2. The radiation output at 6" from a radiation source is 200 rads per hour. Answer the following questions.

   a) How much radiation would the RT get if he stood at the 6" distance for 1 hour?

   b) How much radiation would he get if he stood at the same spot for only 30 minutes?

   c) How much radiation would he get if he stood 2' away from the source for 1 hour?

   d) How much radiation would he get if he stood 3' away for 30 minutes?

3. An x-ray tube has an output intensity of 2.5 rads at a distance of 6 feet. What would be the radiation exposure at 36" from the source?

4. A technologist receives 10 rads/hr. at a distance of two feet from the source of radiation. Will he exceed his hourly MPD if he moves to a distance 3 feet from the source? How far away from the source would the technologist need to be in order not to exceed the MPD?

5. A radiation source is emitting 20 rads/hr. at a distance of one foot. Which is safer...standing one foot from the source for 10 minutes or standing 3 feet from the source for one hour?

PROBLEM 1 ANSWER KEY

In order to correctly solve this problem, units of distance must be the same. The first step is to either convert 2 1/2 feet to inches or convert 30 inches to feet.

METHOD I

Using inches (2 1/2 ft. x 12 in./ft.) as our unit of measure, we get:

intensity(1) = 4 rads distance(1) = 50 in.
intensity(2) = 'x' rads distance(2) = 30 in.

The ratio involving intensity and distance is:

$$\frac{\text{intensity}(1)}{\text{intensity}(2)} = \frac{\text{distance}(2)^2}{\text{distance}(1)^2}$$

Substituting into the formula, we get:

$$\frac{4 \text{ rads}}{'x' \text{ rads}} = \frac{(30 \text{ in.})^2}{(50 \text{ in.})^2}$$

Removing the square, we get:

$$\frac{4 \text{ rads}}{'x' \text{ rads}} = \frac{900 \text{ sq. in.}}{2500 \text{ sq. in.}}$$

Solving for 'x', we get:

$$900x = 10,000$$
$$x = 11.1 \text{ rads}$$

1C

METHOD II

Using feet (50 in. ÷ 12 in./ft.) as our unit of measure, we get:

intensity(1) = 4 rads   distance(1) = 4 1/6 ft.
intensity(2) = 'x' rads   distance(2) = 2 1/2 ft.

Substituting into the formula, we get:

$$\frac{4 \text{ rads}}{\text{'x' rads}} = \frac{(2\ 1/2 \text{ ft.})^2}{(4\ 1/6 \text{ ft.})^2}$$

$$\frac{4 \text{ rads}}{\text{'x' rads}} = \frac{(5/2 \text{ ft.})^2}{(25/6 \text{ ft.})^2}$$

Removing the square, we get:

$$\frac{4 \text{ rads}}{\text{'x' rads}} = \frac{25/4 \text{ sq. ft.}}{625/36 \text{ sq. ft.}}$$

Simplifying the complex fraction, we get:

$$\frac{4 \text{ rads}}{\text{'x' rads}} = \frac{9}{25}$$

Solving for 'x', we get:

$$9x = 100$$
$$x = 11.1 \text{ rads}$$

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PROBLEM 2 ANSWER KEY

a) The amount of radiation the technologist would receive in one hour would be 200 rads.

b) The amount of radiation received in 30 minutes can be found by using the dose/time ratio. **Remember:** Units of time must be the same.

METHOD I

Using minutes (1 hr. = 60 min.) as our unit of time, we get:

dose(1) = 200 rads   time(1) = 60 min.
dose(2) = 'x' rads   time(2) = 30 min.

Substituting into the proportion, we get:

$$\frac{200 \text{ rads}}{\text{'x' rads}} = \frac{60 \text{ minutes}}{30 \text{ minutes}}$$

Solving for 'x', we get:

$$60x = 6000$$
$$x = 100 \text{ rads}$$

METHOD II

Using hours (30 min. ÷ 60 min./hr.) as our unit of time, we get:

dose(1) = 200 rads   time(1) = 1 hr.
dose(2) = 'x' rads   time(2) = 1/2 hr.

Substituting into the formula, we get:

$$\frac{200 \text{ rads}}{\text{'x' rads}} = \frac{1 \text{ hr.}}{1/2 \text{ hr.}}$$

Clearing out the complex fraction, we get:

$$\frac{200 \text{ rads}}{\text{'x' rads}} = \frac{2}{1}$$

Solving for 'x', we get:

$$2x = 200$$
$$x = 100 \text{ rads}$$

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c) Solving this section of the problem requires the use of the intensity/distance proportion:

$$\frac{\text{intensity}(1)}{\text{intensity}(2)} = \frac{\text{distance}(2)^2}{\text{distance}(1)^2}$$

Since the distances being used are two different units of measure, we must change one in order to solve the problem.

METHOD I

Using inches (2 ft. x 12 in./ft.) as our unit of distance, we get:

intensity(1) = 200 rads   distance(1) = 6 inches
intensity(2) = 'x' rads   distance(2) = 24 inches

Substituting into the proportion, we get:

$$\frac{200 \text{ rads}}{'x' \text{ rads}} = \frac{(24 \text{ in.})^2}{(6 \text{ in.})^2}$$

Removing the square, we get:

$$\frac{200 \text{ rads}}{'x' \text{ rads}} = \frac{576 \text{ sq. in.}}{36 \text{ sq. in.}}$$

Solving for 'x', we get:

$$576x = 7200$$
$$x = 12.5 \text{ rads}$$

METHOD II

Using feet (6 in. ÷ 12 in./ft.) as our unit of distance, we get:

intensity(1) = 200 rads   distance(1) = 1/2 ft.
intensity(2) = 'x' rads   distance(2) = 2 ft.

Substituting into the formula, we get:

$$\frac{200 \text{ rads}}{'x' \text{ rads}} = \frac{(2 \text{ ft.})^2}{(1/2 \text{ ft.})^2}$$

Removing the square, we get:

$$\frac{200 \text{ rads}}{'x' \text{ rads}} = \frac{4 \text{ sq. ft.}}{1/4 \text{ sq. ft.}}$$

Simplifying the complex fraction, we get:

$$\frac{200 \text{ rads}}{'x' \text{ rads}} = \frac{16}{1}$$

Solving for 'x', we get:

$$16x = 200$$
$$x = 12.5 \text{ rads}$$

d) In order to solve part d, students must use both proportion formulas given in the lesson.

The students must first compute the amount of radiation received at a distance of 3 feet for 1 hour or the amount of radiation received at 6 inches for 30 minutes. Hopefully the student will notice that he found the amount of radiation received at 6 inches for 30 minutes in part b. If the student picks up this information, he will only use the formula that involves intensity and distance. Using this formula the student must first covert to the same unit of measure. Again we can use either feet or inches as our unit of distance.

METHOD I

Using inches (3 ft. x 12 in./ft.) as our unit of distance, we get:

intensity(1) = 100 rads	distance(1) = 6 in.
intensity(2) = 'x' rads	distance(2) = 36 in.

Substituting into the proportion, we get:

$$\frac{100 \text{ rads}}{'x' \text{ rads}} = \frac{(36 \text{ in.})^2}{(6 \text{ in.})^2}$$

Removing the square, we get:

$$\frac{100 \text{ rads}}{'x' \text{ rads}} = \frac{1296 \text{ sq. in.}}{36 \text{ sq. in.}}$$

Solving for 'x', we get:

$$1296x = 3600$$
$$x = 2.8 \text{ rads}$$

2i

METHOD II

Using feet (6 in. ÷ 12 in./ft.) as our unit of distance, we get:

intensity(1) = 100 rads   distance(1) = 1/2 ft.
intensity(2) = 'x' rads   distance(2) = 3 ft.

Substituting into the formula, we get:

$$\frac{100 \text{ rads}}{\text{'x' rads}} = \frac{(3 \text{ ft.})^2}{(1/2 \text{ ft.})^2}$$

Removing the square, we get:

$$\frac{100 \text{ rads}}{\text{'x' rads}} = \frac{9 \text{ sq. ft.}}{1/4 \text{ sq. ft.}}$$

Simplifying the complex fraction, we get:

$$\frac{100 \text{ rads}}{\text{'x' rads}} = \frac{36}{1}$$

Solving for 'x', we get:

$$36x = 100$$
$$x = 2.8 \text{ rads}$$

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If the student does not pick up on the conversion in part b, the process involves finding the amount of radiation received at 3′ for one hour and then finding the amount received at 3′ for 30 minutes. The first step would involve using the intensity/distance formula. (The same units of distance must be used in the formula.)

METHOD I

Using inches (3 ft. x 12 in./ft.) as our unit of distance, we get:

intensity(1) = 200 rads distance(1) = 6 in.
intensity(2) = 'x' rads distance(2) = 36 in.

Substituting into the proportion, we get:

$$\frac{200 \text{ rads}}{'x' \text{ rads}} = \frac{(36 \text{ in.})^2}{(6 \text{ in.})^2}$$

Removing the square, we get:

$$\frac{200 \text{ rads}}{'x' \text{ rads}} = \frac{1296 \text{ sq. in.}}{36 \text{ sq. in.}}$$

Solving for 'x', we get:

$$1296x = 7200$$
$$x = 5.6$$

METHOD II

Using feet (6 in. ÷ 12 on./ft.) as our unit of distance, we get:

intensity(1) = 200 rads　　　　distance(1) = 1/2 ft.
intensity(2) = 'x' rads　　　　distance(2) = 3 ft.

Substituting into the proportion, we get:

$$\frac{200 \text{ rads}}{\text{'x' rads}} = \frac{(3 \text{ ft.})^2}{(1/2 \text{ ft.})^2}$$

Removing the square, we get:

$$\frac{200 \text{ rads}}{\text{'x' rads}} = \frac{9 \text{ sq. ft.}}{1/4 \text{ sq. ft.}}$$

Simplifying the complex fraction, we get:

$$\frac{200 \text{ rads}}{\text{'x' rads}} = 36$$

Solving for 'x', we get:

$$36x = 200$$
$$x = 5.6 \text{ rads}$$

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We must now use the dose/time proportion to find the number of rads received for 30 minutes at the 3′ distance.

METHOD I

Using minutes (1 hour = 60 minutes) as our unit of time, we get:

dose(1) = 5.6 rads   time(1) = 60 min.
dose(2) = 'x' rads   time(2) = 30 min.

Substituting into the proportion, we get:

$$\frac{5.6 \text{ rads}}{'x' \text{ rads}} = \frac{60 \text{ min.}}{30 \text{ min.}}$$

Solving for 'x', we get:

$$60x = 168$$
$$x = 2.8 \text{ rads}$$

METHOD II

Using hours (30 min. ÷ 60 min./ hr.) as our unit of time, we get:

dose(1) = 5.6 rads   time(1) = 1 hr.
dose(2) = 'x' rads   time(2) = 1/2 hr.

Substituting into the proportion, we get:

$$\frac{5.6 \text{ rads}}{'x' \text{ rads}} = \frac{1 \text{ hr.}}{1/2 \text{ hr.}}$$

Simplifying the complex fraction, we get:

$$\frac{5.6 \text{ rads}}{'x' \text{ rads}} = 2$$

Solving for 'x', we get:

$$2x = 5.6$$
$$x = 2.8 \text{ rads}$$

PROBLEM 3 ANSWER KEY

To solve problem 3, we use the intensity/distance formula.

Before the problem can be solved, make sure the units of distance are the same.

<u>METHOD I</u>

Using inches (6 ft. x 12 in./ft.) as our unit of distance, we get:

intensity(1) = 2.5 rads	distance(1) = 72 in.
intensity(2) = 'x' rads	distance(2) = 36 in.

Substituting into the proportion, we get:

$$\frac{2.5 \text{ rads}}{\text{'x' rads}} = \frac{(36 \text{ inches})^2}{(72 \text{ inches})^2}$$

Removing the square, we get:

$$\frac{2.5 \text{ rads}}{\text{'x' rads}} = \frac{1296 \text{ sq. in.}}{5184 \text{ sq. in.}}$$

Solving for 'x', we get:

$$1296x = 12960$$
$$x = 10 \text{ rads}$$

<u>METHOD II</u>

Using feet (36 in. ÷ 12 in./ft.) as our unit of distance, we get:

intensity(1) = 2.5 rads	distance(1) = 6 ft.
intensity(2) = 'x' rads	distance(2) = 3 ft.

Substituting into the proportion, we get:

$$\frac{2.5 \text{ rads}}{\text{'x' rads}} = \frac{(3 \text{ ft.})}{(6 \text{ ft.})}$$

Removing the square, we get:

$$\frac{2.5 \text{ rads}}{\text{'x' rads}} = \frac{9 \text{ sq. ft.}}{36 \text{ sq. ft.}}$$

Solving for 'x', we get:

$$9x = 90$$
$$x = 10 \text{ rads}$$

PROBLEM 4 ANSWER KEY

In order to solve problem 4, a student must recall the maximum permissible dosage is 100 rads/40 hr. week, which results in 2.5 rads/hour. The student will have to compute the number of rads the technologist would receive if he moved to a distance of 3 feet.

The units of distance are the same, therefore, in order to solve the problem, you must substitute into the intensity/distance formula.

The given information is:

intensity(1) = 10 rads	distance(1) = 2 ft.
intensity(2) = 'x' rads	distance(2) = 3 ft.

Substituting into the proportion, we get:

$$\frac{10 \text{ rads}}{\text{'x' rads}} = \frac{(3 \text{ ft.})^2}{(2 \text{ ft.})^2}$$

Removing the square, we get:

$$\frac{10 \text{ rads}}{\text{'x' rads}} = \frac{9 \text{ sq. ft.}}{4 \text{ sq. ft.}}$$

Solving for 'x', we get:

$$9x = 40 \text{ rads}$$
$$x = 4.4 \text{ rads}$$

The technologist <u>does</u> exceed his MPD because he is receiving 4.4 rads per hour which is over the allowable MPD of 2.5 rads/hour.

In the second portion of problem 4, the student is asked to use the same proportion (intensity/distance) but solve for distance.

The given information is:

intensity(1) = 10 rads	distance(1) = 2 ft.
intensity(2) = 2.5 rads	distance(2) = 'x' ft.

Substituting into the proportion, we get:

$$\frac{10 \text{ rads}}{2.5 \text{ rads}} = \frac{(x \text{ ft.})^2}{(2 \text{ ft.})^2}$$

Removing the square, we get:

$$\frac{10 \text{ rads}}{2.5 \text{ rads}} = \frac{x^2 \text{ sq. ft.}}{4 \text{ sq. ft.}}$$

Solving for 'x', we get:

$$2.5x^2 = 40 \text{ sq. ft.}$$
$$x^2 = 16 \text{ sq. ft.}$$
$$x^2 = 4 \text{ ft.}$$

The technologist must stand at a minimum distance of 4 ft. from the source in order not to exceed the MPD.

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PROBLEM 5 ANSWER KEY

Problem 5 involves the use of both formulas to compute the amount of radiation being received from a given source. To compute the amount of radiation received standing one foot from the source for 10 minutes, the dose/time formula must be used. Units of time must be the same also.

METHOD I

Using minutes (1 hr. = 60 min.) as our unit of time, we get:

dose(1) = 20 rads	time(1) = 60 min.
dose(2) = 'x' rads	time(2) = 30 min.

Substituting into the proportion, we get:

$$\frac{20 \text{ rads}}{\text{'x' rads}} = \frac{60 \text{ minutes}}{10 \text{ minutes}}$$

Solving for 'x', we get:

$$60x = 200$$
$$x = 3.3 \text{ rads}$$

METHOD II

Using hours (10 min. ÷ 60 min./hr.) as our unit of time, we get:

dose(1) = 20 rads	time(1) = 1 hr.
dose(2) = 'x' rads	time(2) = 1/6 hr.

Substituting into the proportion, we get:

$$\frac{20 \text{ rads}}{\text{'x' rads}} = \frac{1 \text{ hour}}{1/6 \text{ hour}}$$

Simplifying the complex fraction, we get:

$$\frac{20 \text{ rads}}{\text{'x' rads}} = 6$$

Solving for 'x', we get:

$$6x = 20$$
$$x = 3.3 \text{ rads}$$

To find the amount of radiation received for one hour at a distance of 3 feet, we must use the intensity/distance formula. Since both units of distance are the same, there is no need to make any conversions.

The given information is:

intensity(1) = 20 rads	distance(1) = 1 ft.
intensity(2) = 'x' rads	distance(2) = 3 ft.

Substituting into the formula, we get:

$$\frac{20 \text{ rads}}{\text{'x' rads}} = \frac{(3 \text{ ft.})^2}{(1 \text{ ft.})^2}$$

Removing the square, we get:

$$\frac{20 \text{ rads}}{\text{'x' rads}} = \frac{9 \text{ sq. ft.}}{1 \text{ sq. ft.}}$$

Solving for 'x', we get:

$$9x = 20$$
$$x = 2.2 \text{ rads}$$

The safer of the options is standing at a distance of 3 feet for a time period of one hour.

GLOSSARY

Allied Health Fields	Those medical areas such as Radiologic Technology, Medical Laboratory Technology, Nursing, or Surgical Technology which provide support services for physicians.
Diverge	To expand from a common point.
Exposure	The condition of being subjected to a certain amount of radiation.
Mid-Level Technology Careers	Those careers which require post-secondary educational training, but not necessarily four years of study.
Nuclear Medicine	The branch of medicine concerned with the identification, treatment, and investigation of disease through the use of radioactive elements.